We claim

1. A method of storing and supplying a gaseous hydrogen product to a pipeline under a product purity specification, said method comprising:

compressing a hydrogen stream made up of gaseous hydrogen to form a compressed hydrogen stream;

introducing the compressed hydrogen stream into a salt cavern for storage of the gaseous hydrogen;

recovering a crude hydrogen stream from the salt cavern;

purifying the crude hydrogen stream by sufficiently removing at least carbon dioxide and water vapor from the crude hydrogen stream to at least in part produce a hydrogen product stream having an impurity level of the carbon dioxide and water vapor at or below the product purity specification; and

supplying the gaseous hydrogen product to the pipeline by introducing said hydrogen product stream into said pipeline.

2. The method of claim 1, wherein:

the gaseous hydrogen is produced by a hydrogen production facility having a hydrogen plant configured to produce the gaseous hydrogen with a higher impurity level of the carbon dioxide and water vapor than the product purity specification and purification equipment configured to purify the gaseous hydrogen to directly produce the hydrogen product stream and to purify the crude hydrogen stream to produce the hydrogen product stream therefrom; and

when demand for the gaseous hydrogen product is below a production capacity of the hydrogen plant,

the hydrogen product stream is formed by directly purifying part of the gaseous hydrogen without recovery of the crude hydrogen stream from the salt cavern and utilizing a remaining part of the gaseous hydrogen as the hydrogen stream for compression and storage in the salt cavern; and

when demand for the gaseous hydrogen product is above the production capacity of the hydrogen plant, the crude hydrogen stream is recovered from the salt cavern and purified to at least in part to produce the product stream.

3. The method of claim 1, wherein:

the hydrogen stream is removed from the pipeline and stored within the salt cavern during periods of low demand for the hydrogen product; and

the hydrogen product stream is introduced into the pipeline during periods of high demand for the hydrogen product.

4. The method of claim 1, wherein:

the crude hydrogen stream is purified by also sufficiently removing hydrogen sulfide;

the product purity specification contains predetermined concentrations of hydrogen sulfide, water vapor and carbon dioxide;

water in a liquid state and other contaminants are removed from the crude hydrogen stream within a coalescing filter;

the hydrogen sulfide, water vapor and the carbon dioxide are removed from the crude hydrogen stream after the coalescing filter by adsorption; and

the hydrogen sulfide is removed before the water vapor and the carbon dioxide.

5. The method of claim 4, wherein:

the hydrogen sulfide is removed within a hydrogen sulfide adsorption bed to form an intermediate product stream; and

the intermediate product stream is introduced into a system of adsorbent beds configured to remove the carbon dioxide and water in an alternating fashion such that one bed is online producing the hydrogen product stream while another bed is an off-line bed being regenerated through desorption.

6. The method of claim 5, wherein:

the system of adsorbent beds are operated in accordance with a temperature swing adsorption cycle;

a subsidiary hydrogen product stream is divided out of the hydrogen product stream and is heated;

the subsidiary hydrogen product stream is introduced into the off-line adsorbent bed, thereby to produce a regeneration stream containing desorbed impurities;

water is separated from the regeneration stream; and

after water separation, the regeneration stream is compressed and recycled back to the coalescing filter.

7. The method of claim 1, wherein the hydrogen stream is compressed to about 2200 psig and the

hydrogen product stream is reduced in pressure to between about 600 psig and about 800 psig.

8. The method of claim 1, wherein the product purity specification of the hydrogen product stream is about 99.99 percent pure hydrogen containing less than about 100 ppmv nitrogen and argon, less than about 1 ppmv of carbon monoxide and carbon dioxide, less than about 1 ppmv methane, less than about 1 ppmv water, and less than about 1 ppmv hydrogen sulfide.